Predicting Purchase Behaviour

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The Juster Scale is a purchase probability scale used to predict the actual purchase rate in a population from a sample of consumers from that population. Several overseas studies have demonstrated the predictive ability of the Juster Scale, particularly for cars. This paper reports the findings of two New Zealand studies involving the Juster Scale. The first confirms the superior predictive ability of the Juster Scale compared to buying intentions scales, and both studies confirm the practicality of using the Juster Scale for predicting purchases of a range of items including durables, services and fast-moving consumer goods. The ability of the Juster Scale to accurately predict car purchases was corroborated, but the accuracy of predictions for other items was variable.

Keywords: Juster Scale, purchase probability, buying intention, purchase prediction

Introduction

Dissatisfaction with the accuracy of predictions of purchase behaviour based on socio-economic and demographic variables led researchers to experiment with consumer buying intentions and attitudes as alternative predictors (Juster 1960; Heald 1970; Gabor & Granger 1972). In short-term cross-sectional studies, buying intentions generally proved more accurate predictors of purchase behaviour than attitudes (Klein & Lansing 1955; Tobin 1959; Adams 1964), but the absolute predictive ability of intentions was still poor (Juster 1966; Theil & Kosobud 1968; Pickering & Isherwood 1974). Thus the focus of efforts to predict purchase behaviour shifted to purchase probabilities, ultimately culminating in the development of an eleven-point purchase probability scale, commonly known as the Juster Scale.

This paper describes the development of the Juster Scale and reviews its application to the prediction of consumer purchases of various items. It then presents the results of two New Zealand studies using this scale and discusses their implications.

Buying intentions

It appears that the poor predictive performance of buying intentions scales is due largely to the way in which intentions are measured. Intentions scales require respondents to express their likelihood of purchase using a number of verbal intention descriptors. Scales range from crude three-point options offering 'yes', 'no' or 'don't know' (Klein & Lansing 1955; Tobin 1959; Heard 1970), to nine-point semantic differentials (Pickering & Greatorex 1980). Most common is a five-point scale giving 'definitely/probably won't buy', 'maybe' and 'probably/definitely will buy'.

Ferber and Piskie (1965) point out how limited the 'yes-no' scale is in enabling respondents to report their intentions. However, even intentions scales with several gradational adjectives lack reliability because respondents interpret them differently (Worcester & Burns 1975). It is also difficult to produce a quantitative estimate of actual purchase rates based on the proportions of respondents in each intention category. However, the main cause of poor predictive performance of intentions is the inability of the intention scale to predict the large

number of actual purchases among the large proportion of respondents reporting no buying intentions (Juster 1966). This was confirmed in a study of new car purchases and intentions by Theil and Kosobud (1968). In an analysis of United States Bureau of the Census data they found that 70% of automobile purchases were made by respondents who had stated no buying intention, while of those who had stated a buying intention, less than 40% actually bought a car.

One solution to this problem, proposed by Mullet and Karson (1985), was to weight intentions data by probabilities generated from past purchase rates collected from a consumer diary panel. Exactly how the probabilities are derived and related to intentions is unexplained, and seems arbitrary. Also, this method does not eliminate the inherent inaccuracy in collecting the original intentions data. Morrison (1979) offers a mathematical model to transform intentions into more accurate estimates, but points out that this is a less desirable option than improved empirical measurement techniques.

Purchase probabilities

To overcome the problem of the high proportion of purchases being made by non-intenders, Juster (1964) suggested using an eleven-point probability scale. He argued that verbal intentions are really disguised probability statements and asked why probabilities should not be collected directly. Not only are consumers familiar with the notion of chances or odds out of ten, which would facilitate questionnaire administration, but the use of additional points on the scale would enable respondents to describe their buying plans more accurately.

Juster also hoped that, given more precise alternatives, the proportion of respondents formerly reporting no or unknown intentions would decrease. Using the mean purchase probability as the predictor, rather than the proportion of intenders, purchase rates among the important non-intender group could be more accurately gauged. The result should be a more accurate prediction of actual purchase rates, and an improved ability to discriminate between buyers and non-buyers (who would report different mean purchase probabilities).

Empirical evidence

Early empirical studies of purchase probabilities originated from the United States and focused on consumer durables. One of the first attempts to measure consumer purchase probabilities was the Consumer Savings Study Project conducted in 1958 by Ferber and Piskie (1965). The purpose of the study was to investigate whether purchase probabilities improved prediction over a six-month period for a range of durables and home improvements. Respondents were asked to indicate the type of plans they had - certain, none, fifty-fifty, or anything in between - rather than the probability that they would buy. The show card, which was called a "plan-o-meter", was labelled as follows:

10	Certain
9	
8	
7	
6	
5	Fifty-fifty
4	
3	
2	
1	
0	No plans at all

The findings of this experiment suggested that the typical consumer can really distinguish only three classes of probabilities, and appeared to indicate that a probability survey does not provide any information not already obtained by the standard intentions surveys.

But as Juster (1966) pointed out, the experiment contained two serious flaws. First, the experiment asked respondents for their buying plans and not the probability of buying. Second, although the "plan-o-meter" card contained an 11-point scale, that is 0 to 10, only three probability classes were labelled. This influenced the respondents' replies and consequently the distribution of the responses was trimodal, with peaks where the values were labelled. The experiment was criticised by Juster (1966) as being more of an intentions survey with a precoded response scale than a survey of purchase probabilities. Thus the Savings Study experiment obtained about the same kind and quality of information as an intentions survey.

The Detroit experiment conducted by Byrnes (1964) was the first phase of an attempt to develop an experimental survey of subjective purchase probabilities. Data on buying plans for cars were sought from 192 respondents, who were asked to indicate their responses on an 11-point probability scale with descriptions for each scale value. The mid point was additionally labelled '50-50', as follows:

10	Absolutely certain to buy	10
9	Almost certain to buy	9
8	Much better than even chance	8
7	Somewhat better than even chance	7
6	Slightly better than even chance	6
5	About even chance (50-50)	5
4	Slightly less than even chance	4
3	Somewhat less than even chance	3
2	Much less than even chance	2
1	Almost no chance	1
0	No chance	0

The distribution of responses in this experiment showed a marked peak at 0.5. Juster (1966) concluded that this was probably due to the scale's emphasis on the midpoint (note how all points from 2 to 8 are expressed in relation to an 'even chance'). He thought that the peak at 0.5 suggested that many respondents were unable to be precise about their plans, and chose the 50-50 value as a way of indicating that their prospects of buying were higher than zero but lower than one. Though the qualitative statements in the scale were symmetrically described in terms of degrees of better than (or less than) an even chance, most respondents apparently found these shadings of little help in selecting the most appropriate choice.

Nevertheless, Juster acknowledged that the Detroit experiment had been successful in highlighting the fact that a substantial number of households classified as non-intenders in a buying plan survey actually reported a non-zero probability, and subsequently purchased. The study provided sufficient evidence of the probability scale's usefulness to encourage Juster to investigate his hypothesis further.

To establish whether the purchase probability scale was superior to intentions scales, Juster (1966) conducted the QSI (Quarterly Surveys of Intentions) Experiment, a fullscale experiment using a modified version of Byrnes' (1964) scale. The scale used in the QSI experiment, and now known as the Juster Scale, used a set of scale point descriptions that were both qualitative and quantitative:

10	Certain, practically certain	(99 in 100)
9	Almost sure	(9 in 10)
8	Very probable	(8 in 10)
7	Probable	(7 in 10)
6	Good possibility	(6 in 10)
5	Fairly good possibility	(5 in 10)
4	Fair possibility	(4 in 10)
3	Some possibility	(3 in 10)
2	Slight possibility	(2 in 10)
1	Very slight possibility	(1 in 10)
0	No chance, almost no chance	(1 in 100)

Six-month, 12-month and 24-month purchase probabilities were obtained for automobiles and a variety of consumer durables from 451 personal interviews. Questions about household financial position and expectations preceded the purchase probability questions, and respondents were also given practice using the scale. Actual purchase data was collected after six months only.

The distribution of purchase probabilities was shaped like an inverse 'J', with peaks at 0 and 1.0 and a trough in between. There was no indication of a peak at the scale mid point of 0.5. The purchase probabilities explained twice as much of the variance in actual purchase rates as buying intentions data. When probabilities were cross-classified with intentions, intenders had consistently higher mean purchase probabilities than non-intenders, as did buyers compared to non-buyers. Approximately 5% of respondents who had reported zero purchase probabilities made purchases, compared to 11% of non-intenders. As a result of these findings, the United States Bureau of Census subsequently shifted to the use of purchase probability scales in their forecasting (Clawson 1971).

Juster found that probability data were more accurate in predicting car purchases than purchases of other household durables. Similar accurate prediction of car purchases by probability data had previously been demonstrated by Byrnes (1964). The predicted automobile purchase rate in Juster's study was lower than the actual purchase rate. However, an automobile strike occurred during the period of observation, reducing supply and presumably attributing to the difference in purchase rates observed. For household durables, Juster did not collect purchase probabilities over six months, but compared 12-month probabilities with six-month purchases. Not surprisingly, the predicted purchase rates were higher than the actual rates.

It is interesting that Juster did not remove from the initial survey those respondents who did not provide data on actual purchases, so his predicted purchases rates are based on a larger sample than actual purchases (451 compared with 395). Nonresponse bias in either direction is a possibility. Another interesting point is that Juster experimented with using 0.025 and

0.975 as the probabilities for the extreme points on the scale, rather than 0 and 1, or 0.01 and 0.99, as written on the scale. Because of the high proportion of zero purchase probability responses, the former method increased the upward bias for durables.

Shortly after Juster's study, Stapel (1968) conducted a survey in the Netherlands which asked respondents to estimate 'the percent chance' of buying a new or used car in that year. The scale also contained probability descriptions referring to the chance of purchase. Results were similar to those of Juster (1966). There was a systematic increase in purchase rates as purchase probabilities rose; for example, 79% of those who stated a 100% chance of purchase did in fact buy. Unfortunately, only 71% of the non-zero probability respondents were re-interviewed. No attempt was made to re-interview the 58% of respondents who stated zero purchase probabilities, nor the 16% who did not indicate any purchase probability. However, the accurate results produced for non-zero purchase probability respondents prompted Stapel to use the scale to pre-test and post-test advertising effectiveness.

Gabor and Granger (1972) tested the purchase probability scale under British conditions. Personal interviews were conducted twelve months apart to collect purchase probabilities and actual purchase data from 548 respondents, the largest known sample obtained in such surveys. The items were all durables, including automobiles, and the Juster Scale was used. Once again, a high proportion of reported purchase probabilities (92%) were zero, and well over half (65%) of all purchases were made by about 5% of the zero probability group.

Purchase rates rose systematically with probabilities, but actual purchase rates were substantially understated by probabilities, with 181 predicted purchases and 306 actual purchases. However, this may not have been caused by the scale alone. Numerous unforeseen events caused unpredicted purchases. The introduction of smokeless zones accounted for several gas and electric fire and central heating purchases. House moves where gas and electric fires or cookers were already installed were considered purchases, yet not all of these can really be classified as 'new' purchases. If more than one gas or electric fire was bought, each was counted as a purchase, yet the questions did not ask for the probability of buying more than one. Given that these items accounted for 40% of total purchases, these factors are important.

Gabor and Granger (1972) hypothesised that unpredicted purchases are strongly related to the purpose of the purchase, whether for replacement or initial acquisition. Thus, low ownership products should be more accurately predicted than high ownership products, since replacement purchases are likely to be due to sudden breakdown or wear. For example, 80% of purchases made by the zero probability group in their study, and 63% of all purchases, were replacements. The proportion of purchases not for replacement rose with probabilities. Juster (1964) also reported high purchase rates among respondents who previously owned the items in question.

Pickering and Isherwood (1974) used personal interviews to collect three-month and 12-month purchase probabilities from 386 households in Britain. A postal survey was used to collect actual purchase data, and a response rate of 72% was obtained. Techniques suggested by Juster above were employed. Probability questions were preceded by other general financial questions, but the scale used contained fewer verbal probability descriptions:

10 Completely certain

9

8

7

6

5

4

3

2

1

0 No Chance

Also included on the showcard used were explanations of the points, such as "A score of 8 would mean you are 80% certain", and so on. Products tested were durables, including cars. In aggregate, predicted and actual purchases were very close; 390 purchases were predicted and 373 occurred, an error of 4%. Again, almost 55% of purchases were made by respondents who reported zero purchase probabilities, and, for individual products, this never fell below 40%. As in other studies, purchase rates rose with probabilities, and buyers had higher mean purchase probabilities than non-buyers.

However, examination of individual products shows both underestimates and overestimates. Pickering and Isherwood (1974) suggested that predictive accuracy was related to ownership and length of planning time. Low ownership items seem to have longer planning periods and their rate of purchase is overestimated, while high ownership items have short planning periods and their replacement is underestimated. This is similar to the hypothesis of Gabor and Granger (1972). Pickering (1975) subsequently analysed the verbal explanations of purchase decisions collected in the survey conducted by Pickering and Isherwood (1974), and these generally supported this hypothesis. Pickering and Greatorex (1980) analysed owners and non-owners, and buyers and non-buyers, and their conclusions also provide evidence for this hypothesis.

The study by Pickering and Isherwood (1974) does not seem to have been affected by the omission of verbal probability descriptions from the scale. In fact, results are somewhat better, with lower purchase rates among households reporting zero purchase probabilities, and more accurate aggregate predictions than in previous surveys. In another survey by Isherwood and Pickering (1975) purchase probabilities were used among other anticipatory variables to analyse automobile purchases in Britain. Purchase probabilities were one of four groups of key discriminators identified as playing an important role in explaining car purchases.

There is general acceptance in the literature that purchase probabilities understate actual purchases (Juster 1966 & 1969; Heard 1970; Pickering & Isherwood 1974). However, on closer inspection this conclusion is questionable. For instance, surveys quoted in support of this observation by Pickering and Isherwood (1974) used intentions data, not purchase probabilities (Murray 1969). As mentioned previously, the underestimates reported by Juster (1966) for automobiles and by Gabor & Granger (1972) have likely biases. Byrnes (1964), Juster (1966), Clawson (1971) and Pickering and Isherwood (1974) report instances of overestimated forecasts. This point remains inconclusive. It seems likely that any pattern of consistent predictive error would be more strongly related to the nature of the product and its ownership level, rather than the purchase probability scale itself.

Further Applications of the Juster Scale

Gruber (1970) investigated whether the purchase probability scale is applicable to low-priced non-durables, specifically food products. Two hundred personal interviews were conducted, in which women were shown photographs of prototypes of sixteen new food items. An intentions scale was compared to the Juster Scale, although no time limit was imposed on purchase.

The result was a positive correlation between responses on the two scales. The purchase probability distribution observed was quite different to that of durable purchase probabilities, in that the majority of respondents reported high purchase probabilities, and there were very few zero purchase probabilities. It remains to be seen whether the scale is equally accurate in predicting purchases among high purchase probability respondents. Unfortunately, no actual purchase data was collected, since the products were not launched.

Clawson (1971) used purchase probabilities in the United States to predict purchases over three months, a shorter period than for previous studies. He also used some lower-priced, frequently purchased services in contrast to the previous concern with high-priced durables. Personal interviews were conducted and 176 respondents provided purchase probabilities and actual purchase data.

All predictions overestimated actual purchases, with an overall predictive error of +19.7%. As seen previously, prediction of automobile purchases was extremely accurate (12.6% compared to 12.5%). However, some of the more seldomly purchased services were very inaccurately predicted, particularly travel outside the state, travel in camper vans, and purchase of shares. Clawson suggested that differences in accuracy may be due to intrinsic differences in products or services. He recommended repeating his research with larger samples before any firm conclusions could be reached.

Clawson saw further benefits for marketing decision makers besides the Juster Scale's ability to yield accurate short term forecasts. He suggested analysis of the high probability respondents for the purpose of improving segmentation and marketing mix decisions. Changes in purchase probabilities might measure short-term advertising effectiveness immediately after exposure, rather than using a distorted measure of its effect on sales.

Some recent studies have used the Juster Scale for different purposes. Miller (1985) conducted a mail survey to estimate the demand for tertiary education in the New Zealand agribusiness sector. No comments were made about any difficulties in using the scale, although two respondents did not answer this question (only 0.6% of the sample). Dobbs

(1985) also used the Juster Scale in a mail survey together with the Delphi technique, to forecast trends in the New Zealand advertising industry. The very small sample of respondents did not report any difficulties in using the scale, and the response to the combination of forecasting techniques was positive. However, as in Miller's (1985) study, respondents were a highly educated, select group.

Two New Zealand studies

The following sections report the findings of two further studies designed to test the use of the Juster Scale for predicting a range of consumer purchases in New Zealand.

The first study (Gan, Esslemont & Gendall 1985) compared the accuracy of three-month purchase predictions for a range of durables, services and fast moving consumer goods made using a conventional buying intentions scale and the Juster Scale. Personal interviews were used to establish the buying plans of 98 Palmerston North households; three months later a follow up survey was conducted by telephone to determine actual purchases. The final sample contained 92 households, 77% of those initially approached.

The study confirmed that the Juster Scale was a better predictor of future purchase rates than the conventional buying intentions scale. This superiority was attributable to the significant proportion of purchases made by respondents who expressed no buying intentions, but indicated a non-zero purchase probability. Of the total purchases made, only 12% were by respondents who had stated a zero purchase probability, compared to 25% by those who had stated no buying intention.

In general, both scales were less successful in predicting purchases of durables than purchases of services or fast-moving consumer goods (though the Juster Scale gave a very accurate prediction of car purchases; 17 predicted versus 16 bought). Buying intentions data did not discriminate buyers from non-buyers well, but mean probability values of purchasers were substantially higher than those of non-purchasers.

The second study (Day 1987) compared two versions of the Juster Scale, the original version and a modified version containing only numerical probabilities and no verbal probability descriptions. Juster (1966) had hypothesised that removing the verbal probability descriptions would improve the predictive accuracy of the scale. Day also examined whether the Juster Scale could be used as successfully in self-completion questionnaires as it had been in personal interviews.

Purchase probabilities for a range of durables, non-durables and services were obtained using a self-completion questionnaire included in a household expenditure diary mailed to a national panel of 1209 New Zealand households. Three months later a further questionnaire asked diarists which of the items had been purchased in the intervening period. Overall, 74% of the 1209 households originally selected provided data on predicted and actual purchase rates.

The standard Juster Scale produced slightly more accurate predictions than the probability-only scale, though evidence for the former's superior predictive power was not conclusive. However, responses to the standard scale were more evenly distributed and non-response levels were consistently lower for the standard scale than for the modified scale. Furthermore, it was clear that at least some respondents were not entirely comfortable with the purely

numerical scale because they supplied their own probability descriptions for it. Consequently Day recommended that the standard Juster Scale, with its verbal probability descriptions, continue to be used. Day's study also confirmed that the Juster Scale can be successfully used in self-completion questionnaires, though special attempts should be made to minimise item non-response.

The accuracy of purchase predictions

A comparison of the three-month purchase predictions made by Gan et al. (1985) and Day (1987) using the Juster Scale, and the actual levels of purchases that occurred is shown in Table 1.

Table 1. Predicted and actual purchase rates: Gan et al.; (1985) and Day (1987)

	Proportion of Households Purchasing Each Item					
	Gan et al. (1985)			Day (1987)		
Item	**Predicted %**	**Actual (n=92) %**	**Error[1] %**	**Predicted %**	**Actual (n=899) %**	**Error[1] %**
Durables						
New or used car	18.5	17.4	+6.3	8.6	7.4	+16.2
Video recorder	3.8	1.1	+245.0	4.7	6.4	-26.6
Washing machine	5.9	2.2	+168.0	4.9	1.5	+227.0
Electric jug	8.0	3.3	+143.0	-	-	-
Food processor	6.4	4.4	+45.5	-	-	-
Compact disc player	-	-	-	2.5	1.5	+67.0
Services						
Bed night	46.4	41.3	+12.4	30.8	22.5	+36.9
Shares or debentures	16.4	12.0	+36.7	30.2	36.5	-17.3
Skiing trip	13.7	9.8	+39.8	-	-	-
Meal out	-	-	-	69.9	71.7	-2.5
Movie	-	-	-	38.7	36.7	+5.5
Fast-Moving Consumer Goods						
LP record or tape[2]	48.4	37.0	+30.8	50.1	27.0	+85.6
Pair of shoes	52.8	55.4	-4.7	-	-	-
Hard cover book	45.1	38.0	+18.7	-	-	-
Paperback book	-	-	-	52.7	50.4	+4.6

Note.
1. % Error = [(predicted purchase rate - actual purchase rate)/actual purchase rate] x 100
2. A questionnaire error contributed to the large error observed in Day's study.

The critical test of the Juster Scale is its ability to predict actual purchase rates. Nine of the 21 predictions made in the two studies reported (43%) were within 20% of the actual purchase rate, five of these within 10%. Purchases which were predicted most accurately were: a meal out, going to a movie, buying a pair of shoes, and buying a paperback book. Items whose purchase rates were poorly predicted included: washing machines, video recorders and electric jugs (in Day's study the difference between actual and predicted purchases of LP records and tapes was large, but this was almost certainly due to the accidental omission of the word "tapes" in the follow-up questionnaire). As found repeatedly in other studies, car purchases were predicted with reasonable accuracy; in general, however, purchases of durables were not well predicted in either Gan et al.'s or Day's study.

One clear pattern emerges from these results; there is a positive correlation ($r = 0.55$) between predicted purchase rate and error of prediction. The higher the predicted purchase rate for an item, the more accurately the purchase level is likely to be predicted. This is not surprising, since we would expect households to be able to predict acquisition of frequently used, inexpensive items more accurately than that of rarely purchased, major items. When purchase rates are low, any unexpected or deferred purchases have a major impact on the relationship between actual and predicted purchases.

For 17 of the 21 cases detailed in Table 1, predicted purchase rates were higher than actual purchase rates. This is contrary to Juster's (1966) suggestion that probability responses tend to underestimate actual purchases. The theory suggested by Gabor and Granger (1972) and Pickering and Isherwood (1974), that predictive accuracy for durables is related to ownership levels and length of purchase planning period, also received little support from the studies reported here. Purchases of high ownership items (cars, washing machines and electric jugs) were not underestimated as their hypothesis suggests, though purchases of low ownership items were over estimated.

Though studies of purchasing behaviour commonly group items into categories such as durables, services, and fast-moving consumer goods, in the hope of gaining a general understanding about a product category rather than an individual item, this process may be misleading. In her study, Day in fact grouped the ten items concerned into four groups on the basis of the similarity of purchase probability distributions. Thus Day combined cars, video recorders, washing machines and compact disc players and called them durables; shares or debentures and called them services; LPs or tapes, a visit to the movies and paperback books and called them fastmoving consumer items; and treated restaurant meals as a category on its own. Her conclusion was that relative price and frequency of purchase determined the degree of similarity or dissimilarity between items.

Conclusions

The Juster Scale has been shown to be a better predictor of consumer purchases than buying intentions scales, and it can be successfully used in both face-to-face and self-completion surveys and for forecasting periods ranging from three months to a year. The ability of the scale to accurately predict car purchases has been consistently demonstrated, however, the accuracy of predictions for other items is variable.

Though most of the predictions made in the two studies reported in this paper overestimated actual purchases, it would be wrong to conclude that this is a general phenomenon without further study (particularly as several other researchers have reported the opposite). There was

no evidence in these studies to support the hypothesis that purchases of low ownership items should be more accurately predicted than those of high ownership items (because of the impact of replacement purchases). In fact, apart from cars, durables purchases, whether of high or low ownership items, were not accurately predicted in either Gan et al.'s or Day's studies. What we can say is that the higher the predicted purchase rate for an item, the more likely it is that the actual purchase rate will be accurately predicted.

Previously, probability surveys preceded probability questions with other questions related to household financial circumstances, in an effort to sensitise respondents and obtain more thoughtful (and presumably) more accurate probability estimates. This was not done in Gan et al.'s study, and in Day's study it was hoped that prior completion of the household expenditure diary would achieve this end. Thus it is possible that the predictions made in these two studies would have been more accurate if respondents had been explicitly questioned about their general financial circumstances and expectations before being asked their purchase intentions.

Both Gan et al.'s and Day's studies were concerned with estimating the likelihood of a household purchasing a particular item within a given period. No attempt was made to estimate the number of items a household might buy. However, for fastmoving consumer goods in particular, it is generally more useful to predict the quantity of items bought or total expenditure on such items, rather than merely what proportion of households will purchase at least one. In other words, to predict total demand.

It is more than 25 years since Juster first developed his purchase probability scale, but, for marketers, predicting consumer behaviour is still as important now as it was then. The fact that the Juster Scale is a less than perfect predictor of purchase rates for some items should not distract attention from its successful performance for other items. There will always be an element of unpredictability in consumer behaviour, and, like all forecasting methods, the Juster Scale is an aid to informed judgement, not a substitute for it.

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